Personal Intersection Speed Advisory System(PISAS)

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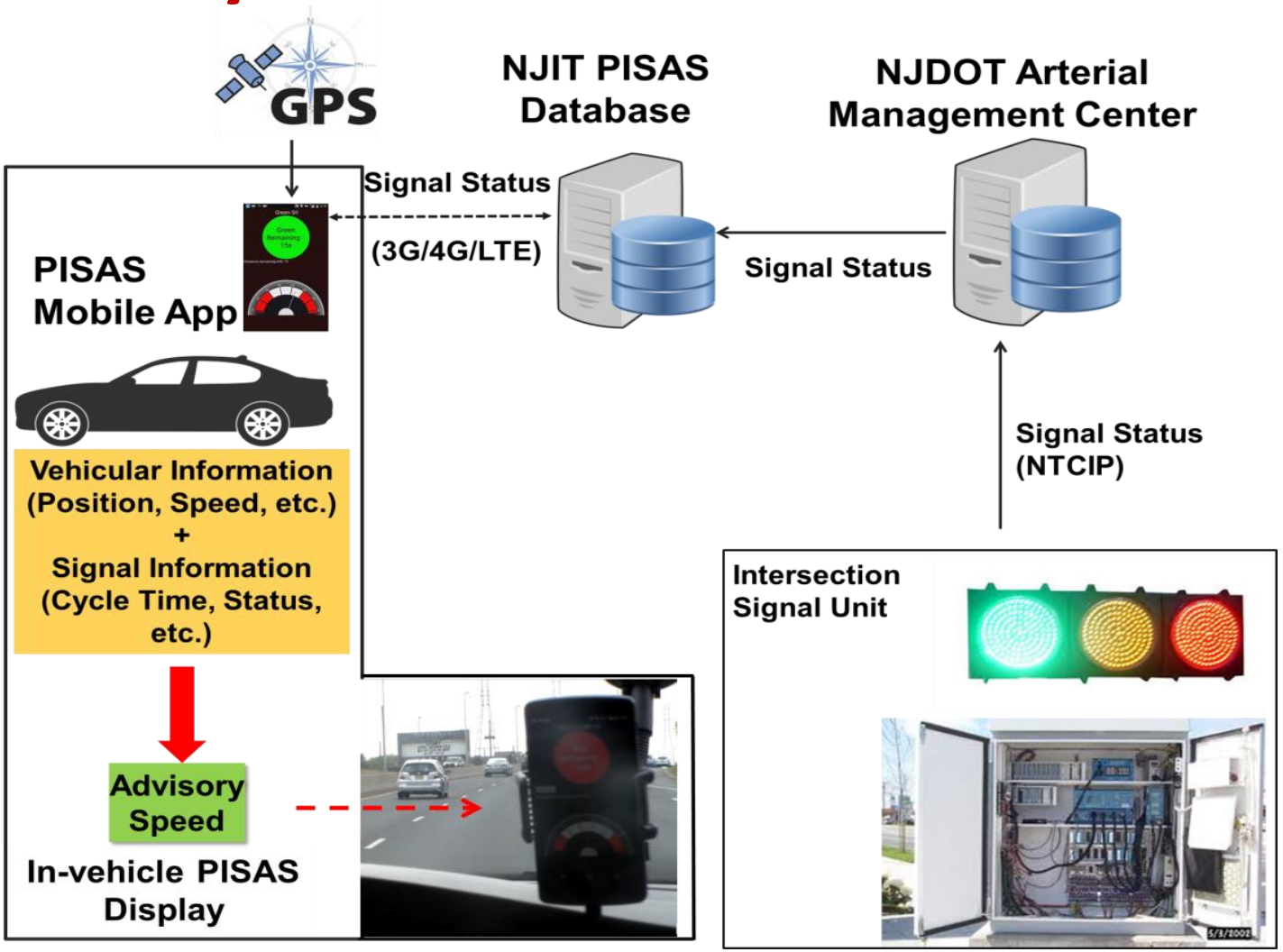
Motivation

Provide individual drivers with safe and efficient speed advisory information at intersections by utilizing real-time traffic and signal status through existing communications infrastructure

Background

- The pilot test of a personal signal assistant application has been conducted in Germany under pre-timed control system
- The application is only available with high-end vehicle models equipped with a proper opt-in device
- NJIT research team developed a mobile phone-based PISAS application to encourage more participants

Overall System Architecture



Speed Advisory Algorithm

End of Green

End of Red

Current Position

Current Speed

Calculate Advisory Speed (Red Interval)

Calculate Advisory Speed (Green Interval)

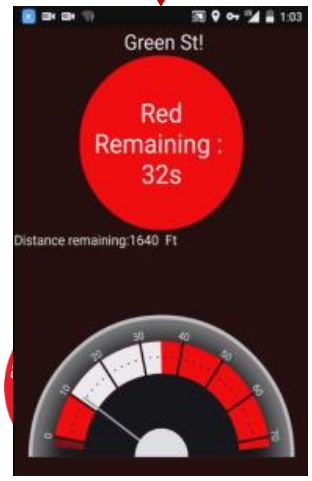
Min Speed ~ Speed Limit

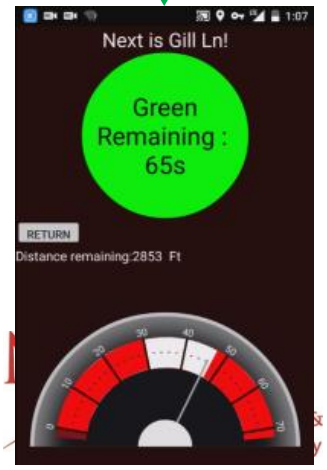
Min Speed ~ Max Speed

Speed Change Not Acceptable

Min Speed ~ Max Speed

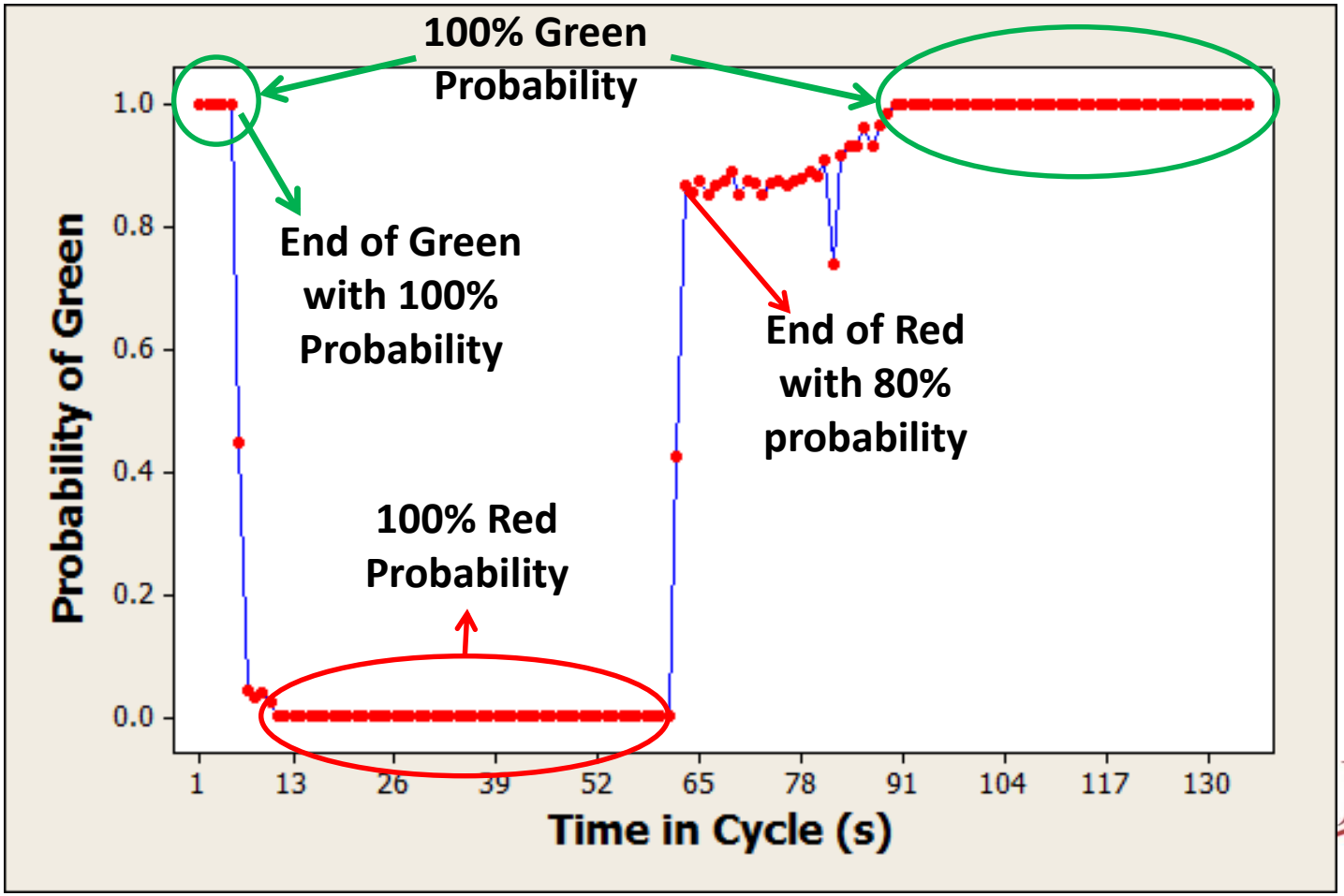
Min Speed ~ Speed Limit



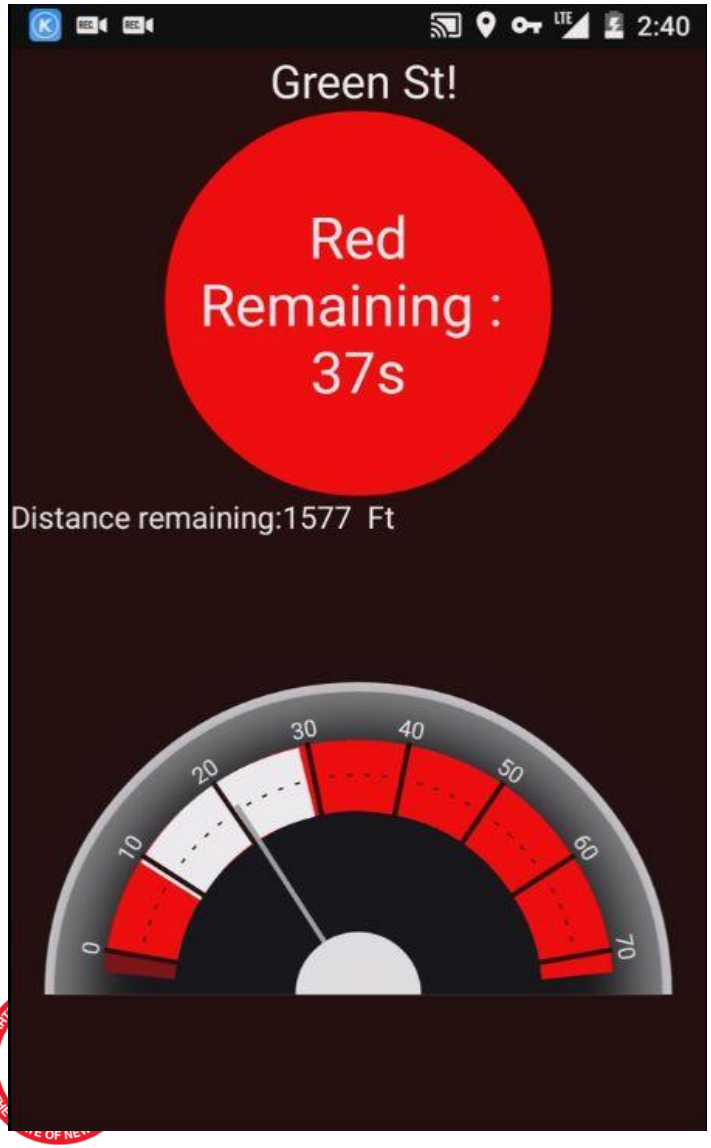


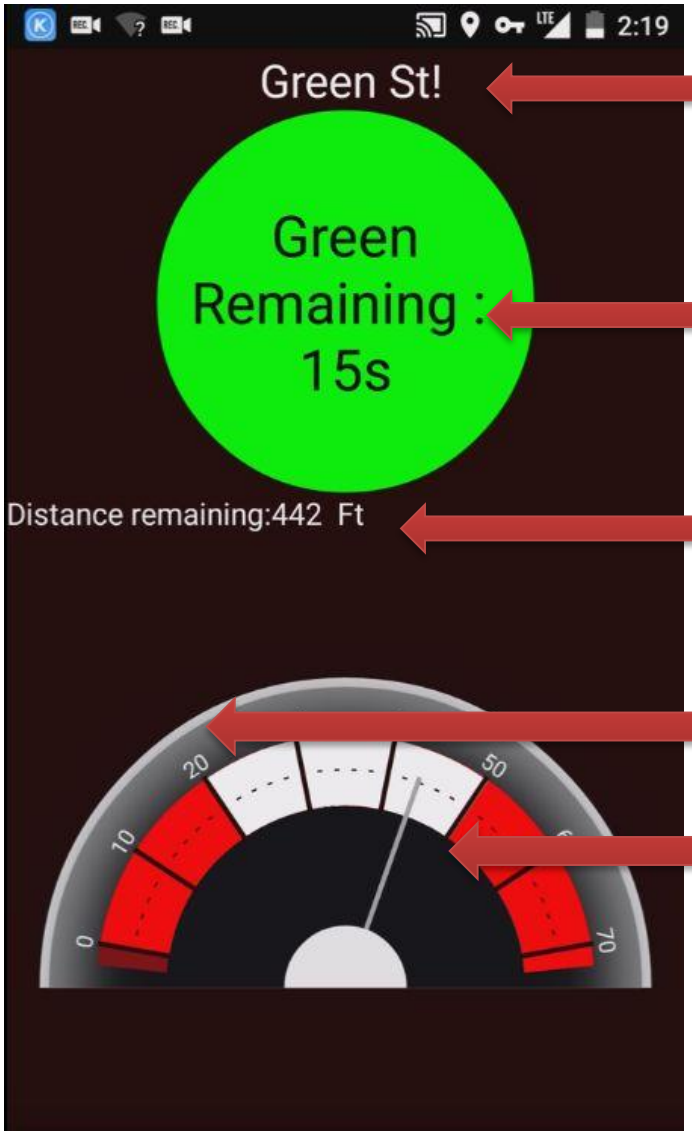
End of Green/Red Determination

- The corridor consist of fully actuated intersections
- End of Green/ Red may vary and it is not fixed
- Probabilistic approach combined with history data used for prediction



PISAS Mobile Application





Intersection Name

Signal Status

Remaining Distance

MIN Advisory Speed

MAX Advisory Speed

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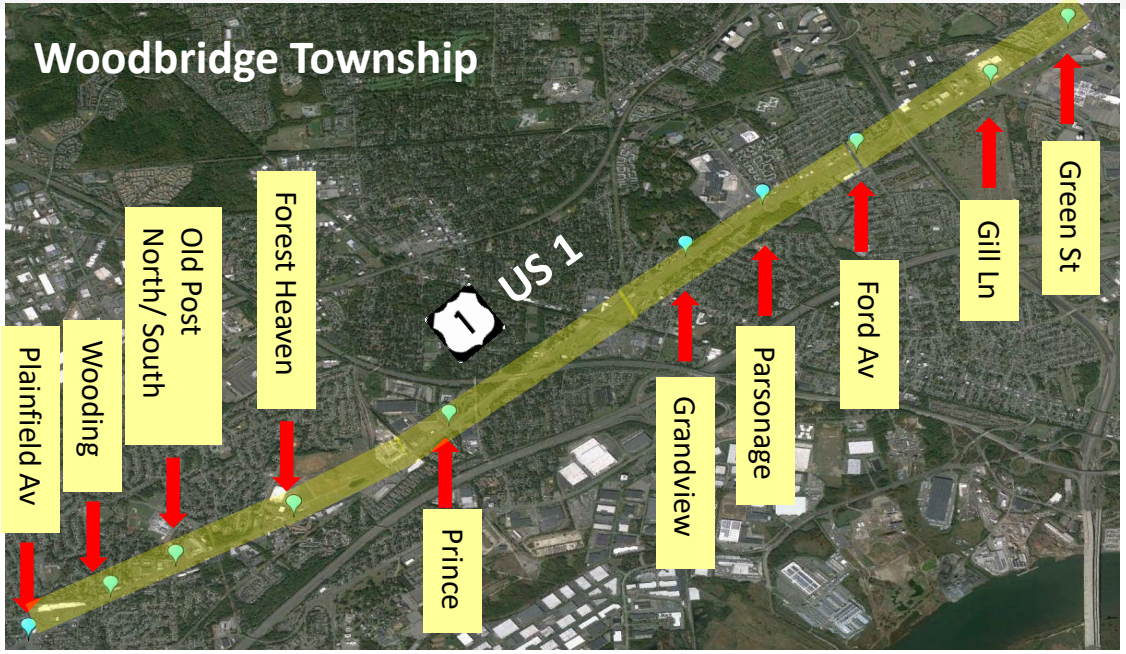
Pilot Test Corridor : US-1 (Green St. – Plainfield Ave.)

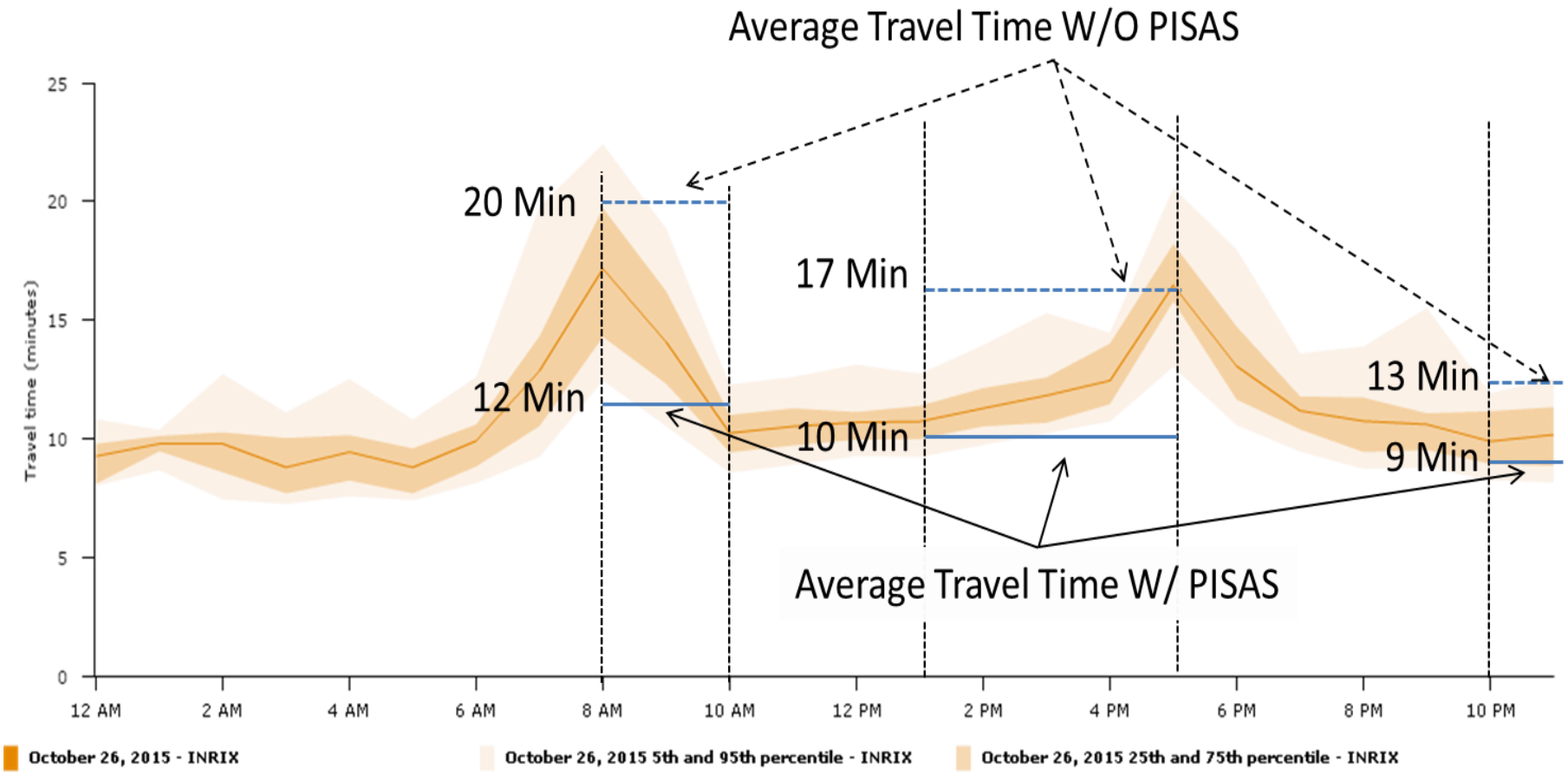
Intersection ID Number	Major Street	Minor Street	Milepost
1401	US 1	Green St	35.69
1402	US 1	Gill Ln	35.10
1403	US 1	Ford Ave	34.24
1404	US 1	Parsonage	33.64
1405	US 1	Grandview Ave	33.07
1406	US 1	Prince St	31.48
1407	US 1	Forest Haven Blvd	31.10
1408	US 1	Old Post Rd North	30.54
1409	US 1	Old Post Rd South	29.88
1410	US 1	Wooding Ave	29.52
1411	US 1	Plainfield Av	29.06



Evaluation Results

Evaluation Period	8 AM- 10AM		1PM-5PM		10 PM-12AM		Average	
Test Type	W/ PISAS	W/O PISAS	W/ PISAS	W/ PISAS	W/O PISAS	W/O PISAS	W/ PISAS	W/O PISAS
Average Travel Time (min)	12	20	10	9	13	17	10.3	16.7
Number of runs	4	4	5	5	4	4	13	13
Travel Time Saving (min)	8		7		4		6.4	

Results


Average Travel Time W/O PISAS
20 Min
17 Min
13 Min
12 Min
10 Min
9 Min
Average Travel Time W/ PISAS
Travel time (minutes)
25
20
15
10
5
0
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
October 26, 2015 - INRIX
October 26, 2015 5th and 95th percentile - INRIX
October 26, 2015 25th and 75th percentile - INRIX

Concluding Remarks

- On the 6.5-mile test corridor, 6.4 minutes of average travel time savings were recorded
- Differences between PISAS and unequipped vehicle were more obvious during AM and off-peak hours
- During peak-hours the vehicle is often forced to follow prevailing speed maintained by the traffic

Concluding Remarks

- PISAS is a DSRC-free V2I Connected Vehicles Application that requires no additional roadside equipment to obtain advisory speed
- PISAS is designed to exploit commercial cellular network service (i.e., 3G and 4G-LTE)
- PISAS system can be easily plugged into existing traffic control management system to capture real-time traffic signal data
- PISAS enables rapid implementation without significant additional cost

Future Research

- Evaluate PISAS using various performance measures to address:
  - Effectiveness of the PISAS application in improving mobility and environmental performances
  - Quality of wireless communications (e.g., communication delay, packet drop).
- Expand test corridor to implement PISAS field test
- Develop an interface enabling direct connection from a traffic controller to a PISAS device

Questions

Advisory Speed Flowchart

R: Target Distance to trigger (e.g., 200 m)
X : Distance to the intersection (unit: meter)
v : Current vehicle speed (unit: km/h)
ss : Current signal controller clock (unit:sec)
GreenEnd : End time of Green signal (unit: sec)
RedEnd: End time of Red signal (unit:sec)
Amber : Yellow time (unit: sec)
rg : remaining green time (rg = GreenEnd+Amber-ss) (unit: sec)
rr : remaining red time (rr = RedEnd-ss) (unit: sec)
SigSTA = Current Signal Status (Green:0, Red: 1, Yellow: 2)
a : Estimated Acceleration/Deceleration Rate (unit: m/sec^2)
av : Advisory Speed (m/sec)
MaxSpeed : Max Speed for Control (e.g., Speed Limit)
MinSpeed : Min Speed for Control (e.g., 30 km/h)